MESSAGING SYSTEM PROVIDING MESSAGE REDUNDANCY REDUCTION

Background of the Invention

Field of the Invention

This invention generally relates to messaging systems and, more particularly, to two-way messaging systems.

Description of the Related Art

Two-way messaging devices, personal communication services (PCS) telephones and the like that enable both receipt and transmission of messages through means of airwave transmissions are well known in the art. An example of such devices is described in United States patent number 4,994,797, (hereinafter referred to as the '797 patent) issued February 19, 1991 to Breeden for "Method and System for User Controlled Message Disposition" which is assigned to Motorola, Inc, the assignee of the present invention. As shown in the '797 patent, the system infrastructure includes a computer terminal connected to sources of calls in the form of a data terminal, with a modem and an auto-dialer, and telephones. The input devices are connected into a public branch exchange, or PBX, which selectively connects these input devices to the two-way messaging terminal. The two-way messaging terminal communicates into the PBX by means of a controller and a supervisor that is connected to a microprocessor via a data bus. The microprocessor has a data base memory, and is connected through a data bus to a transmit controller and an encoder which, in turn, is

connected to a transmitter via a data bus. Reference should be made to the '797 patent, which is hereby incorporated by reference, if further details relating to the conventional infrastructure of a two-way messaging system are desired.

In a two-way messaging system, the two-way messaging device identifies itself to the infrastructure each time it originates a message using a two-way messaging device identification number, or PIN (personal identification number). This PIN is transmitted to the receiving device to enable the receiving device to identify the originator of the message. In addition, each message is assigned a message identifier code by the system infrastructure for future referencing of the message.

The transmitted message includes several conventional segments or components. First, the message includes a header containing a preamble. The preamble includes the device PIN number to identify the originating two-way messaging device to the system infrastructure and further includes a synchronization portion to enable subsequent synchronized transmission. Following the header, the message further includes the device address of the intended receiving two-way messaging device. Next, the message includes a message data. Frequently, following the message data, the message includes a signature. The signature, for example, can be a device user name, a two-way messaging device number, or a telephone number.

When the transmitted message comprises a reply message, the reply message typically includes a portion of the original received message for which the reply corresponds. Further, data bits frequently are included in the reply message as an indication to the receiving device of the type of message being received.

One disadvantage of conventional messaging systems is the substantial amount of overhead traffic in the messaging signals. Frequently, this overhead traffic includes redundant information. Although an original message signal varies with each message and is unknown to the receiving messaging device, the redundant overhead traffic is relatively fixed and repeated. The redundant information can be in each messaging signal sent by a particular messaging device, or in each messaging signal received by a particular messaging device, or can be repeated by reply to a message originally sent by and stored within a messaging device.

Disadvantageously for the service provider, redundant overhead traffic typically includes non-revenue generating data. For example, in conventional messaging systems, a reply message includes a portion of the original message being responded to for the purpose of assisting the reply recipient in recalling the original message. This repetition of the characters of the original message that is included for clarity and convenience are not considered "sent" characters and there is thus no charge to the user, although there is a related cost to the service provider.

Disadvantageously for the device user, there are other kinds of overhead traffic that are billed to the user. For instance, typically, a device user appends each message sent with a signature such as the sender's name, messaging device address and/or telephone number. Signature characters are typically charged to the user. Similarly, a greeting that is included in the message, such as the first name of the recipient (ie. "Joe-"), is also charged to the user.

What is needed to overcome the above disadvantages of the known messaging systems is an overhead traffic reducing, redundancy-reducing, messaging system.

Brief Description of the Several Views of the Drawings

The present invention will be described by way of exemplary embodiments, but not limitations, illustrated in the accompanying drawings in which like references denote similar elements, and in which:

FIG. **1** is a functional block diagram of an embodiment of a two-way messaging system providing message redundancy reduction in accordance with the present invention;

FIG. **2** is a functional block diagram of an embodiment of a two-way messaging device with message redundancy reduction;

FIG. **3** is a functional block diagram of a two-way messaging terminal providing message redundancy reduction;

FIG. **4** is an illustration of a signal format of a signature message that is sent from the two-way messaging device of FIG. **2** to the two-way messaging terminal of FIG. **3**;

FIG. **5** is an illustration of a signal format of an attachment signature message sent from the two-way messaging device of FIG. **2** to the two-way messaging terminal of FIG. **3**;

FIG. **6** is an illustration of a signal format of a redundancy reduced signal;

FIG. **7** is an illustration of a signal format of a message signal sent to the two-way messaging device of FIG. **2** by the two-way messaging terminal of FIG. **3**, in response to receipt of the redundancy reduced signal of FIG. **6**;

FIG. **8** is an illustration of a signal format of a second redundancy reduced signal;

FIG. **9** is a format and content of a message displayed on the two-way messaging device of FIG. **2**;

FIGs. **10** and **11** form a composite logic flow chart of a computer program stored in a terminal operating software memory of the two-way messaging terminal of FIG.**3** in accordance with the present invention; and

FIGs. **12** and **13** form a composite logic flow chart of a computer program that is stored in an operating software memory of the two-way messaging device of FIG. **2** in accordance with the present invention.

Detailed Description of the Invention

As required, detailed embodiments of the present invention are disclosed herein; however, it is to be understood that the disclosed embodiments are merely exemplary of the invention, which can be embodied in various

forms. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting; but rather, to provide an understandable description of the invention.

Referring to FIG. **1**, an embodiment of a two-way messaging system **20** is illustrated. The two-way messaging system **20** includes a plurality of two-way messaging devices such as a two-way messaging device **22**, a sending two-way messaging device **21**, and a receiving two-way messaging device **23**, and a two-way messaging terminal **24** each providing message redundancy reduction. While this embodiment shall be described with reference to two-way messaging devices such as two-way paging devices, it will be appreciated by one of ordinary skill in the art that the present invention described herein is also equally capable of being used with other like two-way messaging devices, such as PCS telephones, or messaging-telephones, and could also be used with voice messaging products in which the messages are converted to voice, or video two-way messaging devices. Accordingly, in the following description, including the specification and the claims, the term "two-way messaging device refers to any of the devices mentioned above or an equivalent. Similarly, in the following description, including the specification and the claims, the term "two-way messaging terminal" refers to any terminal capable of communicating with a least one of the types of two-way messaging devices in the manner described herein.

Further, any reference to a two-way messaging device **22** hereinafter refers to a two-way messaging device providing message redundancy reduction. Similarly, any reference to the two-way messaging terminal **24** refers to a two-way messaging terminal providing message redundancy reduction.

The two-way messaging terminal **24** in accordance with the present invention is connected to a land based telephone system **26**. Regular one way paging devices (not shown) and regular two-way messaging devices **28** without message redundancy reduction can also be present in the two-way messaging system **20**, and the message redundancy reducing features of the present invention advantageously do not interfere with their use and operation in concert with the two-way messaging terminal **24**. The two-way messaging terminal **24** interfaces with the two-way messaging device **22** in accordance with the present invention, and the regular two-way messaging devices **28** via airwave communications. It will be appreciated by one of ordinary skill in the art that the two-way messaging system **20**, in accordance with the present invention, may function utilizing airwave communications including any wireless RF channel, for example, a one or two-way pager channel, a mobile cellular channel, or a mobile radio channel. Similarly, it will be appreciated by one of ordinary skill in the art that the two-way messaging system **20** may function utilizing other types of channels such as infrared channels. In the following description, the term "airwave communications" refers to any of the airwave communication systems mentioned above or an equivalent.

Messaging signals preferably are sent from the sending two-way messaging device **21** through the land based telephone

system **26** to the two-way messaging terminal **24** that is local to the receiving two-way messaging device **23**. The two-way messaging terminal **24** that is local to the receiving two-way messaging device **23** then sends the message via airwave transmission to the receiving two-way messaging device **23**. Messages can be sent or received in this manner from the two-way messaging device **22** in accordance with the present invention or the regular two-way messaging devices **28** anywhere in the world where airwave communication is available. Messages can also be sent directly to the two-way messaging device **22** from a telephone or microcomputer or other like message source that is linked by landline connection or mobile link to the land based telephone system **26**.

Referring to FIG. **2**, the two-way messaging device **22** in accordance with the present invention is illustrated. It will be appreciated by one skilled in the art that the two-way messaging device **22** can be the sending two-way messaging device **21**, the receiving two-way messaging device **23**, the regular two-way messaging device **28**, or an equivalent. The two-way messaging device **22** of FIG. **2** includes an antenna **40**, a transceiver **42**, an EEPROM **32**, a RAM **34**, a microprocessor **30**, a keypad **36**, a display **38** and preferably a battery **44**.

To facilitate performance of the two-way messaging device **22** in accordance with the present invention, the microprocessor **30** provides message redundancy reduction capability. The microprocessor **30** utilizes conventional signal processing techniques for processing received messages. Preferably, the microprocessor **30** is similar to the MC68328 micro-controller manufactured by Motorola, Inc.

of Schaumburg, Illinois. It will be appreciated that other similar processors can be utilized for the microprocessor **30**, and that additional processors of the same or alternative type can be added as required to handle the processing requirements of the microprocessor **30**.

To perform the necessary functions of the two-way messaging device **22**, the microprocessor **30** is coupled to the electrically erasable programmable read-only memory (EEPROM) **32** and the random access memory (RAM) **34**. The RAM **34** stores message data including a message identifier that is assigned to each message.

Preferably, the keypad **36** is coupled to the microprocessor **30** for manual input to the microprocessor **30**. Further, preferably, the display **38** is coupled to the microprocessor **30**. The display **38** receives signals from the microprocessor **30** to display messages or other control and programming information such a visual notification of the receipt and storage of a message. The display **38** can be, for example, a full or partial starburst liquid crystal display utilized to display text. It will be appreciated that other similar displays such as dot matrix displays can be utilized for the display **38**.

The antenna **40** intercepts transmitted signals from the two-way messaging system **20**. The antenna **40** is coupled to the transceiver **42**, which employs conventional demodulation techniques for receiving the message signals transmitted by the two-way messaging system **20**. When a message is signal is received by the transceiver **42**, the transceiver **42**, coupled to the microprocessor **30**, sends the demodulated signal to the microprocessor **30** for further processing. For example, the microprocessor **30** decodes an address in the

demodulated data of the received message, compares the decoded address with one or more addresses stored in the EEPROM **32**, and when a match is detected, proceeds to process the remaining portion of the received message signal. The transceiver **42** further transmits message signals via the antenna **40** to the two-way messaging system **20**. The transceiver **42** is coupled to the microprocessor **30** and is responsive to commands from the microprocessor **30**. When the transceiver **42** receives a command from the microprocessor **30**, the transceiver **42** sends a message signal via the antenna **40** to the two-way messaging system **20**.

Preferably, the two-way messaging device **22** includes the battery **44**, which can be rechargeable, for providing portable power for all of the other components of the two-way messaging device **22** providing message redundancy reduction.

The EEPROM **32** of FIG. **2** includes an operating software memory **46** in which a computer program that operates in accordance with the logic flow chart of FIGs. **12** and **13** is stored and controls the operating functions of the microprocessor **30**. The EEPROM **32** also includes an address book memory **48** for storing signatures and associated addresses or PINs, or two-way messaging device identification numbers, preferably in a lookup table. The EEPROM **32** also includes a greetings memory **50** for storing standard greeting for the user of the two-way messaging device(e.g. "Joe-").

Referring to FIG. **3**, an embodiment of the two-way messaging terminal **24** for use within the two-way messaging system **20** of FIG.**1** is illustrated. The two-way messaging terminal **24** includes a terminal microprocessor **52**, a

terminal transceiver **54**, a terminal antenna **56**, a terminal RAM **58**, and a terminal EEPROM **66**.

The terminal antenna **56** intercepts transmitted signals from the two-way messaging system **20**. The terminal antenna **56** is coupled to the terminal transceiver **54**, which employs conventional demodulation techniques for receiving the message signals transmitted by the two-way messaging system **20**. When a message signal is received by the terminal transceiver **54**, the terminal transceiver **54**, coupled to the terminal microprocessor **52**, sends the demodulated signal to the terminal microprocessor **52** for further processing. For example, the terminal microprocessor **52** decodes an address in the demodulated data of the received message, compares the decoded address with one or more addresses stored in the terminal EEPROM **66**, and when a match is detected, proceeds to process the remaining portion of the received message signal. The terminal transceiver **54** further transmits message signals via the terminal antenna **56** to the two-way messaging system **20**. The terminal transceiver **54** is coupled to the terminal microprocessor **52** and is responsive to commands from the terminal microprocessor **52**. When the terminal transceiver **54** receives a command from the terminal microprocessor **52**, the terminal transceiver **54** sends a message signal via the terminal antenna **56** to the two-way messaging system **20**.

The terminal microprocessor **52** utilizes conventional signal processing techniques for processing received message signals. Preferably, the terminal microprocessor **52** is similar to the MC68328 micro-controller manufactured by Motorola, Inc. of Schaumburg, Illinois. It will be appreciated that other similar processors can be utilized

for the terminal microprocessor **52**, and that additional processors of the same or alternative type can be added as required to handle the processing requirements of the terminal microprocessor **52**.

To perform the necessary functions of the two-way messaging terminal **24**, the terminal microprocessor **52** is coupled to the terminal EEPROM **66** and the terminal RAM **58**. Messages are stored in the terminal RAM **58**. The message identifier assigned to each message passed through the two-way messaging terminal **24** is also stored in the terminal RAM **58**.

Operating software providing message redundancy reduction is stored in a terminal operating software memory **60** of the terminal EEPROM **66** that controls the terminal microprocessor **52** in accordance with the logic flow chart of FIGs.**10** and **11**. The terminal EEPROM **66** also includes a sending device address book memory **62** for storing the two-way messaging device identification numbers and the associated signatures of the sending two-way messaging devices **21** that are sending redundancy reduced messages with respect to the signature, preferably in a lookup table. The terminal EEPROM **66** further includes a receiving device address book memory **64** for storing the PIN numbers of the receiving two-way messaging devices **23** that have stored signatures of the sending two-way messaging devices **21**.

In accordance with the present invention, in one embodiment, the two-way messaging terminal **24** sends non-reduced messaging signals to receiving two-way messaging devices **23** in response to receipt of a message signal from a sending two-way messaging device **21** with codes representative of information to be added to display of the

message on the display **38** of the receiving two-way messaging device **23**. The receiving two-way messaging device **23** in this scenario displays the non-reduced message without alteration on the display **38**. The codes are preferably status bits contained within a header of the message signal.

Alternatively, in the case of receiving two-way messaging devices **23** that already have stored the information represented by the status bits, or other codes, the redundancy reduced messaging signals with codes representative of information to be displayed at the receiving two-way messaging device **23** as part of a message are forwarded to the receiving two-way messaging device **23** without alteration, including the codes. The receiving two-way messaging device **23** responds to the codes forwarded by the two-way messaging terminal **24** in the message signal by displaying messages with the information represented by the codes received along with the message data on the display **38**.

Preferably, the two-way messaging terminal **24** has redundancy reducing capabilities, and the two-way messaging device **22** is capable of either producing messages in response to the non-reduced signals without alteration or to respond to the codes in a redundancy reduced message to add the information represented by the codes to the message as displayed on the display **38**.

The codes can represent commands to insert at least one of the types of message components such as: (a) senders signature, (b) original message segment to which a reply message is a response, and (c) a personalized greeting. Each redundancy reduced messaging signal can have any one, any two or all three of the codes. One skilled in the art will

appreciate that the codes can represent commands to insert any of the types of message components described above or an equivalent.

Unlike message compression devices or other devices that employ message short hand techniques ("canned messages"), the receiving two-way message device **23** responds to the codes as commands to insert information the receiving two-way message device **23** already has in its possession and which is not necessarily known to the sending two-way messaging device **21** or the two-way messaging terminal **24**, and also which is not necessarily the same in each received message.

The receiving two-way messaging device **23** has stored in the appropriate section of the EEPROM **32** and, in response to receipt of the appropriate codes, produces from storage for display on the display **38** the message components such as: (a) the senders signature, (b) a segment of an original message to which a reply message is a response, and (c) a personalized greeting, respectively in response to receipt of a message with the corresponding codes commanding the display of such message components.

In the case of a command to add a segment of an original message, the two-way messaging terminal **24** responds to a code from the sending two-way messaging device **21** by adding a message identifier of an original message to which the reply is a response. The receiving two-way messaging device **23** responds to the code and to the message identifier by adding a segment of the original message to a message display of the reply message.

In the case of the two-way messaging device **22** lacking the information corresponding to the codes in the redundancy reduced message signal corresponding to commands to insert

the signature or a segment of the original message, the receiving two-way messaging device **23** automatically transmits a special message to the two-way messaging terminal **24** requesting refreshment of its address book memory **48** or the section of RAM **34**. This information is then transmitted back to the two-way messaging device **22** by the two-way messaging terminal **24**.

FIG. **4** is one embodiment of a signal format for informing the two-way messaging terminal **24** of the signature that is to be added to a message when the appropriate code is sent by the sending two-way messaging device **21**. Specifically, FIG. **4** is an illustration of the signal format of a signature message **68** that is sent from the sending two-way messaging device **21** of FIG. **2** to the two-way messaging terminal **24** of FIG. **3** to provide the two-way messaging terminal **24** with a signature **70** of the sending two-way messaging device **21** for storage in the sending device address book memory **62** of the two-way messaging terminal **24**. For example, the sending two-way messaging device **21** can send the signature message **68** of FIG. **4** whenever the signature **70** is initially set or is changed in the sending two-way messaging device **21**. The signal format for the signature message **68** includes a header **72**, wherein the header includes a preamble **74** and one or more status bits **76**. The status bits **76** can be special characters or bit settings indicating that the signature **70** follows. The signature message **68** further includes a messaging terminal address **78**, a message data **80**, and the signature **70**. Preferably, the messaging terminal address **78** is an address indicating the signature message **68** is intended for one or more two-way messaging terminals such as the two-way

messaging terminal **24**. It will be appreciated by one of ordinary skill in the art that the messaging terminal address **78** can be any of the addresses mentioned or an equivalent. Typically, the message data **80** portion of the signature message **68** is empty since the key purpose of the signature message **68** is to send the signature **70**. However, one skilled in the art will appreciate that the message data **80** of the signature message **68** can include information other than the signature **70** for use by the two-way messaging terminal **24**. The two-way messaging terminal **24** responds to receipt of the signature message **68** by storing the signature **70** contained in the signal in the sending device address book memory **62**, FIG. **3**, along with the associated PIN number that is contained in the header **72**.

FIG. **5** is another embodiment of a signal format for informing the two-way messaging terminal **24** of the signature **70** that is to be added to a message when the appropriate code is sent by the sending two-way messaging device **21**. Specifically, FIG. **5** is an illustration of the signal format of an attachment signature message **82** that is sent from the sending two-way messaging device **21** of FIG. **2** to the two-way messaging terminal **24** of FIG. **3** to provide the two-way messaging terminal **24** with the signature **70** of the sending two-way messaging device **21** for storage in the sending device address book memory **62** of the two-way messaging terminal **24**. For example, the attachment signature message **82** can be the next regular message sent by the sending two-way messaging device **21** after the signature **70** of the sending two-way messaging device **21** has been initially set or changed. The signal format for the attachment signature message **82** includes the header **72**, wherein the header

includes the preamble **74** and one or more status bits **76**. The status bits **76** can be special characters or bit settings indicating that a message data and the signature **70** follow. The attachment signature message **82** further includes a receiving two-way messaging device address **84**, the message data **80**, and the signature **70**. Preferably, the receiving two-way messaging device address **84** is an address indicating the message data **80** is intended for one or more two-way messaging devices such as the receiving two-way messaging device **23**. It will be appreciated by one of ordinary skill in the art that the receiving two-way messaging device address **84** can be any of the addresses mentioned or an equivalent. Preferably, the attachment signature message **82** further includes a signature control character **86**. The signature control character **86**, abbreviated "SIG. CC" in FIG. **5**, marks where the message data **80** ends and the signature **70** for storage in the sending device address book memory **62** begins. Upon receipt of the attachment signature message **82**, the two-way messaging terminal **24** updates the sending device address book memory **62** with the signature **70** along with the associated PIN number that is contained in the header **72**; and also processes the message data **80** to forward the message data **80** to the receiving two-way messaging device **23**.

FIG. **6** is an illustration of the signal format of a redundancy reduced signal **88** that alternatively is created at the two-way messaging terminal **24** or is created by the sending two-way messaging device **21** and forwarded by the two-way messaging terminal **24** without alteration to the receiving two-way messaging device **23**. The redundancy reduced signal **88** of FIG. **6** includes the header **72**, wherein

the header **72** includes the preamble **74** and one or more status bits **76**. The preamble **74** of the header **72** preferably includes the PIN associated with the sending two-way messaging device **21** which originated the redundancy reduced signal **88**. The status bits **76** can be special characters or bit settings indicating that redundancy elimination of either or both of the signature **70** and a message greeting have been implemented in conjunction with the message data **80**. The status bits **76** further represent a command to add the signature **70** or other message addendum to the message data **80**. The status bits **76**, for example, can be the codes representing commands to insert at least one message component such as: (a) senders signature, (b) original message segment to which a reply message is a response, and (c) a personalized greeting. Each redundancy reduced messaging signal can have any one, any two or all three of the codes. One skilled in the art will appreciate that the status bits **76** can represent commands to insert any of the types of message components described above or an equivalent. The redundancy reduced signal **88** further includes the receiving two-way messaging device address **84** and the message data **80**. Preferably, the receiving two-way messaging device address **84** is an address indicating the message data **80** is intended for one or more two-way messaging devices such as the receiving two-way messaging device **23**. It will be appreciated by one of ordinary skill in the art that the receiving two-way messaging device address **84** can be any of the addresses mentioned or an equivalent.

When the redundancy reduced signal **88** with a signal format of the form shown in FIG. **6** that lacks the signature

70 but contains the status bits **76** in the header **72** representing a command to add the signature **70** is received by the two-way messaging terminal **24** from the sending two-way messaging device **21**, the two-way messaging terminal **24** responds by looking for the signature **70**. The two-way messaging terminal **24** checks in the receiving device address book memory **64** to determine whether the receiving two-way messaging device **23**, as identified by the receiving two-way messaging device address **84** has the signature **70** of the sending two-way messaging device **21** stored in the address book memory **48**, FIG. **2**, of the receiving two-way messaging device **23**. When it is determined that the signature **70** of the sending two-way messaging device **21** is not stored at the receiving two-way messaging device **23**, then the two-way messaging terminal **24** unsets the status bits **76** indicating that a signature **70** needs to be added and, itself, adds the signature **70** to the signal before forwarding it to the receiving two-way messaging device **23** in the signal format shown in FIG. **7**.

FIG. **7** is an illustration of the signal format of a message signal **90** sent to the receiving two-way messaging device **23** by the two-way messaging terminal **24**, in the case of receipt of the redundancy reduced signal **88** having the format shown in FIG. **6** and with the status bits **76** indicating that the signature **70** should be added, which is used when the receiving two-way messaging device **23** is not message redundancy reduction enabled, itself, to produce the signature **70** directly in response to the redundancy reduced signal **88**. The message signal **90** of FIG. **7** includes the preamble **74**, wherein the preamble **74** preferably includes the

PIN associated with the sending two-way messaging device **21** which originated the redundancy reduced signal **88**. The message signal **90** further includes the receiving two-way messaging device address **84**, the message data **80**, and the signature **70**. Preferably, the receiving two-way messaging device address **84** is an address indicating the message data **80** is intended for one or more two-way messaging devices such as the receiving two-way messaging device **23**. It will be appreciated by one of ordinary skill in the art that the receiving two-way messaging device address **84** can be any of the addresses mentioned or an equivalent.

Alternatively, when the two-way messaging terminal **24** determines that the receiving two-way messaging device **23** already has stored the signature **70** of the sending two-way messaging device **21**, then the status bits **76** indicating addition of the signature **70** remains set, and the signal is forwarded without signature, in the format of the redundancy reduced signal **88** shown in FIG.**6**, for addition to the displayed message by the receiving two-way messaging device **23**. Similarly, the status bits **76** can indicate not only the addition of the signature **70** but also the addition of a greeting stored in the greetings memory **50** of the receiving two-way messaging device **23**. When the receiving two-way messaging device **23** receives such a signal with the status bits **76** set to add the greeting, then the greeting stored in the greetings memory **50** of the EEPROM **32** is automatically added to the front of the message data **80** for display on the display **38**, FIG. **2**.

FIG. **8** is an illustration of the signal format of a second redundancy reduced signal **92** that alternatively is created at the two-way messaging terminal **24** or is created

by the sending two-way messaging device **21** and forwarded by the two-way messaging terminal **24** without alteration to the receiving two-way messaging device **23**, and in which the status bits **76** in the header **72** indicate redundancy elimination of transmission of an original message segment to which the current message is a reply, as identified by a message identifier **94** and appended to the message data **80**. The second redundancy reduced signal **92** of FIG. **8** includes the header **72**, wherein the header **72** includes the preamble **74** and one or more status bits **76**. The preamble **74** of the header **72** preferably includes the PIN associated with the sending two-way messaging device **21** which originated the second redundancy reduced signal **92**. The status bits **76** can be special characters or bit settings indicating redundancy elimination of transmission of an original message segment to which the current message is a reply have been implemented in conjunction with the message data **80**. The status bits **76** further represent a command to add the message identifier **94**, the signature **70**, and/or other message addendum to the message data **80**. The redundancy reduced signal **88** further includes the receiving two-way messaging device address **84** and the message data **80**. Preferably, the receiving two-way messaging device address **84** is an address indicating the message data **80** is intended for one or more two-way messaging devices such as the receiving two-way messaging device **23**. It will be appreciated by one of ordinary skill in the art that the receiving two-way messaging device address **84** can be any of the addresses mentioned or an equivalent.

When the two-way messaging terminal **24** receiving a reply message in a redundancy reduced signal **88** of the format of

FIG. **6** with the status bits **76** indicating addition of a segment of the original message to which the reply message is a response, and then the two-way messaging terminal **24** appends the message identifier **94** of the original message. This message identifier **94** is stored with the original message in the terminal RAM **58**. After the message identifier **94** has been added then the second redundancy reduced signal **92** is sent with a signal format shown in FIG. **8**.

When the receiving two-way messaging device **23** receives the second redundancy reduced signal **92** with the status bits **76** set for adding the original message segment, it looks for, reads and uses the message identifier **94** to locate the original message segment stored in the RAM **34** and adds it to the end of the reply message when displayed on the display **38**, FIG. **2**.

FIG. **9** is the format and content of a message **96** displayed on the display **38** of the receiving two-way messaging device **23** in response to an original message with status bits **76** for redundancy elimination of the original message segment, greeting and signature. As illustrated, the message **96** that is displayed when all three status bits have been set includes a greeting **98**, the message data **80**, an original message segment **100** and the signature **70** that has been added either at the two-way messaging terminal **24** and sent to the two-way messaging device **22** or which is added by the receiving two-way messaging device **23**, itself.

FIGs. **10** and **11** form a composite logic flow chart of a computer program stored in the terminal operating software memory **60** of the two-way messaging terminal **24** of FIG.**3** to control the two-way messaging terminal **24** in accordance with

the present invention. After the start **102**, a determination is made in step **104** whether the signature message **68** has been received having the signal format of FIG. **4**. When the signature message **68** has not been received, the process continues to step **106**. In step **106**, a determination is made whether the attachment signature message **82** has been received having the signal format shown in FIG. **5**.

Returning to step **104**, when the signature message **68** has been received, the process continues to step **108**. In step **108**, the sending device address book memory **62** is updated. The sending device address book memory **62** is updated with the two-way messaging device identification number and the associated signature **70**, which were both sent with the signature message **68**. When a previous signature is stored in associated with the received PIN, then it is erased and overwritten with the new signature. The signature **70** can contain several components such as the name of the user, the two-way messaging device email address and the telephone number of the user. The process then returns to step **102**, start.

Referring again to step **106**, when the attachment signature message **82** has been received, the two-way messaging terminal **24** automatically removes the signature control character **86** and forwards the message with the signature **70** attached. The process then moves to Step **108**, wherein the sending device address book memory **62** is updated with the two-way messaging device identification number and the associated signature **70**, which were both sent with the signature message **68**. When a previous signature is stored in associated with the received PIN, then it is erased and

overwritten with the new signature. The process then returns to step **102**, start.

The advantage of this approach is that it eliminates the cost of sending the signature message **68** for the sole purpose of updating the signature **70**, and further eliminates the need for recognizing the signature message **68**. Nonetheless, some users wish to change their signature immediately and not wait until the next message. Preferably, as indicated by the logic flow chart both methods are made available, but it must be recognized that only one is required in order for the two-way messaging system **20** to function as intended.

When in step **106**, a determination is made that the attachment signature message **82** has not been received, then the program moves to step **112** to determine whether the redundancy reduced signal **88** has been received with a status bits **76** set commanding addition of a signature **70** either by the two-way messaging terminal **24** or by the receiving two-way messaging device **23**. When the redundancy reduced signal **88** has not been received, the program moves to Step **120**. When a message having the redundancy reducing signal **88** format of FIG. **6** has been received with one of the status bits **76** set to indicate addition of the sender's signature, the process moves to step **114**. In step **114** it is determined whether the signature associated with the PIN of the sending two-way messaging device **21** has been stored at the receiving two-way messaging device **23** in the address book memory **48**, FIG. **2**. When the signature has been stored at the receiving two-way messaging device **23**, then in step **116**, the message is sent to the receiving two-way messaging device **23** in a redundancy reduced format of FIG. **6** with the status bits **76**

still set for addition of the signature **70**. When the signature has not been stored at the receiving two-way messaging device **23**, then in step **118**, the two-way messaging terminal **24** unsets the status bit, looks up the signature based upon the PIN of the sending two-way messaging device **21** that appears in the header **72**, and appends the signature to the message signal before forwarding to the receiving two-way messaging device **23**. The program then moves on to Step **120**.

The program in step **120** then moves to step **122** of FIG. **11**. Next, at step **124**, the program determines whether the received message signal includes the status bits **76** in the header **72** indicate redundancy elimination of transmission of an original message segment to which the current message is a reply. When the received message signal includes status bits indicating a reply including redundancy elimination of transmission of an original message segment, the process moves to step 126 in which the two-way messaging terminal **24** looks up the message identifier **94** stored in the terminal RAM **58** and appends it to the message data **80** before it is forwarded to the receiving two-way messaging device **23**. The format of the forwarded signal is the second redundancy reduced signal **92** corresponding to that shown in FIG. **8**. When in step **124** the status bits **76** for a reply are not set, or after the message identifier **94** is added in step **126**, the program proceeds to step **128**.

At step **128**, a decision is made as to whether the status bits **76** include a command to add the greeting **98** is included in the received message signal. When the status bits **76** for adding the greeting **98** is set, then in step **130** the status bits **76** are maintained in a set condition, and

the redundancy reduced message signal is then forwarded to the receiving two-way messaging device **23** in step **132**. One, two all three of the status bits **76** can be set or none of the status bits **76** can be set. When all three are set, then format of the message that when finally displayed at the receiving two-way messaging device **23** is the message **96** as shown in FIG. **9**.

In the message **96** shown in FIG. **9**, the message **96** has all three components that have been added in response to set status bits **76**. The message **96** includes the greeting **98** that is inserted by the receiving two-way messaging device **23** from the greetings memory **50**. The original message segment **100** identified by the message identifier **94** is taken from the RAM **34** of the receiving two-way messaging device **23** and appended to the message data **80**. The signature **70** that is identified by the PIN number of the received message signal and taken from the address book memory **48** of the EEPROM **32** is added to the end of the message **96**. Alternatively, the actual signature is sent by the two-way messaging terminal **24** from the sending device address book memory **62** in response to receipt of the second redundancy reduced messaging signal **92**.

After the message **96** is forwarded in step **132**, and when no greeting is requested in step **128**, next in step **134**, the program monitors for receipt of a request for signature message from the receiving two-way messaging device **23** requesting that the signature **70** be sent in case the sending two-way messaging device **21** signature **70** cannot be found in storage at the two-way messaging device **22**. When the two-way messaging terminal **24** receives the request for signature message, then in step **136**, the signature **70** is pulled from

the sending device address book memory **62** and sent to the requesting two-way messaging device **23** as the signature message **68** from the two-way messaging terminal **24**.

Next, and when no request for signature message is received in step **134**, in step **138** a determination is made as to whether a message has been received from the receiving two-way messaging device **23** requesting the original message associated with the reply received by the receiving two-way messaging device **23**. When the two-way messaging terminal **24** receives such a message, then in step **140**, the original message segment **100** is retrieved from the terminal RAM **58** and sent to the requesting two-way messaging device **22**.

After this information is sent, or when there is no request, the program returns to normal operation in step **142** in which it redundantly responds to conventional messaging signals. Likewise, a messaging signal of the invention that is received with none of the status bits **76** set will be treated the same as in normal operation with no message redundancy reduction action being taken. Then, the program in step **144** returns to start **102** of FIG. **10**.

FIGs. **12** and **13** form a composite logic flow chart of a computer program that is stored in the operating software memory **46** of the two-way messaging device **22** of FIG. **2** to control the two-way messaging device **22** in accordance with the present invention. Referring to the logic flow chart, after start **146**, in step **148** a determination is made as to whether the user has selected the user program mode. When the user program mode is entered, then in step **150** the user can setup or amend the address book memory **48** and setup or amend the greetings memory **50**. The user can setup or amend the address book memory **48** or the greetings memory **50** using

the keypad **36**. Similarly, the user can choose from a menu of pre-stored choices, or can program the address book memory **48** or the greetings memory **50** using a programming device. It will be appreciated by one skilled in the art that the user can setup or amend the user can setup or amend the address book memory **48** or the greetings memory **50** using one of the methods mentioned above or an equivalent.

When the user program mode is not entered in step **148**, then next in step **152** a decision is made whether a message signal has been received with a signature status bit set such as the message signal **90** of FIG. **7**. When the message signal **90** is received, then next in step **154** the PIN contained in the preamble **74** of the message signal **90** is used to look up the signature **70** in the address book memory **48**. Next, in step **156**, when the signature **70** is found, then in step **158** the signature **70** is appended to the message **96** displayed on the display **38** as shown in FIG. **9**.

When the signature **70** is not found in step **156**, then in step **160**, a message is sent to the two-way messaging terminal **24** requesting the signature **70**. Next, in step **162**, the program awaits receipt of the signature message **68** with the signature information. When the signature **70** is received, in step **164** the signature **70** is stored in the address book memory **48**. The program then proceeds to step **158**, and the signature **70** is appended to the message **96** for display on the display **38**. When the signature message **68** is not received, or upon completion of step **158**, the program next proceeds to step **166**.

Referring to FIG. **13**, from step **168**, the program proceeds to step **170** at which it is determined when the received message signal has a status bit set commanding the

appending of a segment of an original message to which the received reply message is a response such as the second redundancy reduced signal **92** of FIG. **8**. When this bit is set, then in step **172**, the message identifier **94** of the second redundancy reduced signal **92** is used to look up the original message. In step **174**, when the original message is not found, for example because of being purged from the memory or for any other reason, then in step **176**, a message is sent to the two-way messaging terminal **24** requesting the original message segment **100** be sent to the receiving two-way messaging device **23**. In step **178**, the program checks for receipt of the original message segment **100**. When the original message is received in step **178**, then next in step **180**, the received original message segment is stored. Next, in Step **182**, the original message segment **100** is appended to the message data **80** before displaying on the display **38**. Likewise, when the original message is found in step **174**, then the program proceeds to step **182** to append the original message segment **100** directly from its own memory.

After the original message segment **100** is appended in step **182**, or when in step **170**, the status bit representative of the command to add the original message segment is not set or when the original message is not received in step **178**, the program proceeds to step **184**. In step **184**, a determination is made whether the received message signal has a status bit directing the receiving two-way messaging device **23** to add a greeting **98** to the message data **80**. When this status bit is set, then in step **186** the greeting **98** is added to the front of the displayed message. The program then continues to step **190**. When no greeting is required in step **184**, then in step **188**, the message is displayed without

the addition of a greeting. Next, in step **190**, the entire message is displayed with all the additions indicated by the three different status bits **76** to the extent that information was made available by either the two-way messaging terminal **24** or the two-way messaging device **22**, itself. Next, in step **192**, the program returns to start **146**, FIG. **12**.

While a particular embodiment has been disclosed in detail, the scope of the invention is not limited to such detail but rather is defined by the appended claims. For instance, although only three types of redundancy have been identified for reduction by the present invention, it should be appreciated that any other type of information in a message, that is already available at the receiving end of a transmission can be redundancy reduced in accordance with the teaching of the present invention. Also, although status bits that are selectively set are the codes that are used in the disclosed embodiment and the codes are contained within the header for conveying commands, it should be appreciated that other codes could also be employed successfully to achieve the redundancy reducing object of the present invention.

Although the invention has been described in terms of preferred embodiments, it will be obvious to those skilled in the art that various alterations and modifications can be made without departing from the invention. Accordingly, it is intended that all such alterations and modifications be considered as within the spirit and scope of the invention as defined by the appended claims.

What is claimed is: